

**Research Partnerships Involving Industry,
Government and Universities: The Management Challenge**

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Introduction

The past few years have seen an increasing trend towards cooperative research involving industry, government laboratories and universities working together on well-defined research targets. There are several reasons why cooperative research has become more popular in Canada. With technology changing rapidly, most organizations cannot develop all the technology they may require. As science and technology become more complex, interdisciplinary research has become more of a necessity requiring increased resources to support the activity. Current technology is very much knowledge based, requiring highly trained persons to carry out the research and a sophisticated infrastructure to support its development. These necessities are increasingly expensive to acquire and very expensive to maintain. As a result, many organizations requiring research and development in order to maintain their competitive edge or to develop new economic opportunities are not able to afford the human resources or the infrastructure to fully support their needs. For many years, industry has sought out collaboration in different types of partnerships with university researchers, as has government, but until recently the industry/government interface has been poorly developed. There is now strong encouragement for government laboratories to work more closely with industry on targeted research projects.

Cooperative research is also increasing in fields related to the development of frontier resources such as the Arctic and the eastern Canadian offshore. The reason for this is, to a large extent, the exceptionally high cost of doing research work. Most research projects related to the offshore are also interdisciplinary and require extensive infrastructure support which is very difficult for one organization to maintain in a state-of-the-art position.

At C-CORE, practically all research projects are carried out on a cooperative basis with industry or government, sometimes with both sectors and as well with the involvement of professors from Memorial University and other universities. The principle of cooperative research with all three sectors was a deliberate practice established by C-CORE several years ago in order to maximize the human, financial and logistic resources which can be brought to bear on the development of ocean related technology. C-CORE operates within a market-driven long term research plan, revised annually to reflect industry priorities. The involvement of industry and government groups in the research planning process enables identification of the most appropriate partners required to achieve the research objectives early in the project. The management system in place for research partnerships at C-CORE draws on the strengths of the industrial and academic sectors. Since its inception, project management traditional within industry has been emphasized at C-CORE. Simple but very effective systems for management and cost control have been put in place. The management system however takes into consideration the need to provide an intellectually stimulating environment where academic priorities are supported. The freedom to publish, to follow new research directions and to educate and train scientists and engineers is built into the C-CORE management system.

The Management Challenge

Management of cooperative research projects involving researchers from all three sectors presents a particular challenge. Each sector has its own management system and tribal customs. Industry may vary from a very structured management organization to one verging on the chaotic. Governments are usually highly structured and university professors typically resist anything suggesting an organized management system or control. Often one or more of the organizations have researchers who work under a collective agreement or under different employment terms and conditions which may directly affect the cooperative work that is carried out. These features present a formidable challenge for management to achieve the research objectives within the budget and allowed time frame.

Key Elements of the Management System

1) The Environment for Effective Research Partnerships

One of the most important aspects of successful cooperation on a targeted research project is the environment in which the research is carried out. By this we do not mean the physical setting but a combination of factors that set the conditions for the work. First the research needs should be well defined. This will usually determine the most appropriate team which should be put together to carry out the work. The conditions of work should provide for sufficient freedom for creativity but it should be carried out within a well developed cost control mechanism and with a reasonable time schedule with clearly identified milestones where appropriate. The role of each partner should be clear and their introduction to the project should come at the right stage. One individual must have overall management responsibility as well as responsibility for cost control and project scheduling. This individual does not have to be the most senior technical person on the team. In fact it probably shouldn't be, but rather it should be an individual who has a global view of the technology to be developed, its potential market applications and have the ability to inspire enthusiasm in the team members for the project.

The management system must take into consideration the need to provide an intellectually stimulating environment where academic priorities can be supported. It is important that the right to publish and the manner in which the work will be published be established at the outset. This is particularly important for academic participants but it has also proven to be important for the industry and government participants as well.

The members of the team must be convinced that collaboration will be to their benefit. No amount of "top down" management will make the project succeed without their participation. Realistic expectations of the product or products which will result from the work should be defined early in the research process and results must be presented in an intelligible way to colleagues not completely immersed in the technology.

The management system must take into consideration the cultural differences of team members. University professors who require freedom to publish their work and to follow their instincts in new research directions, sometimes appear to the industrial partner as having little concern for deadlines or budgets.

Participants from industry have, as their primary interest, the potential profitability in the market place and a need to meet project deadlines which is often dictated by cash flow requirements. On the other hand, they may have a lesser appreciation of the thought process involved in the evolution of a research product. The strengths of both cultures, industry and university, must be mobilized in the research environment to ensure an effective project.

ii) Project Responsibility

It is very important that all of the participants in a cooperative research environment agree that one individual be assigned the responsibility for the project management and the cost control. An ideal model for this type of work is the NSERC Cooperative R&D programs although it is usually limited to industry and university organizations and often does not include government organizations in the project. Recent adjustments to the program have declared a number of government departments eligible for cooperative R&D funding with university partners.

iii) Project Focus

The project must be manageable, which is another way of saying that it should have a clear focus. It is important that the targets and tasks are well defined.

iv) Putting Together the Team

The most important component of a cooperative R&D project is the research team. Getting the right skills is not always easy. If an organization is involved in cooperative R&D, it must have a very extensive network and an in-depth knowledge of the science and technology community within which it works. Location is not nearly as important as it once was for most research. Location of laboratory equipment may have a very strong bearing on where work is carried out. The researchers can be located in areas well removed from the main target of the research.

All members of the team will not necessarily be committed to the project for 100% of his or her time, but will be allocated to the project for a portion of their time. This requires management to balance the priorities for allocation to the project and take into consideration priorities of projects of each of the cooperating group.

C-CORE is managing a successful cooperative R&D project team involving government, university, and industry with participants from two continents. This is an example where a team has been put together to address a very important issue related to development of oil and gas reserves in the offshore Canadian Arctic. The team involves an industrial consulting organization and its laboratory located in Calgary, a government organization in Bedford, Nova Scotia, the equivalent of a crown corporation in France as well as universities and faculties in Montreal and Ottawa with C-CORE as the lead research institute in St. John's. The program is designed to fill a need for a reliable predictive model which will have a great bearing on the cost of the offshore facility under

development and may indeed dictate what mode of development is used. The team has been drawn together to bring the most appropriate skills that have been defined from past projects over a period of 12 years. Each of the participants has its own network of contacts within a general area of technology. The research team fell into place very quickly as the most logical group to bring the best capability to bear on this important problem. The project also involves a number of graduate students. An interesting feature in this case is that the research work of graduate students and the preparation of their theses will be supervised by the industry and government participants as well as university-based researchers.

v) Cost and Project Control

Simple but very effective systems for cost control must be developed for cooperative projects. At C-CORE, the management system in place for research partnerships draws on the strength of both the industrial and academic sector. Since the Centre's inception, a project management system traditionally within industry rather than a government or university system has been adopted. However, it is important that the cost control and management system not be so rigid as to inhibit creative thinking and research productivity.

Rapid communication of project status between the participants and where required, the financial supporters of the work can be achieved with a very simple reporting form. The form (Figure 1) allows the participants to see at a glance where they are in terms of the cost, how progress is in relation to milestones that have been established and by exception, what needs to be done to put the work back on target if it has slipped. It requires a simple computer-generated form or a regular printed form; either way it must have one feature which is an anathema to academics: the time sheet. The system simply won't work unless all of the participants cooperate in producing regular reports, weekly at the longest, on charges that have been made to the project and on the progress that has been achieved. With this simple process cost can be seen in relation to what was planned, as well as progress in terms of the original schedule.

vi) Communication

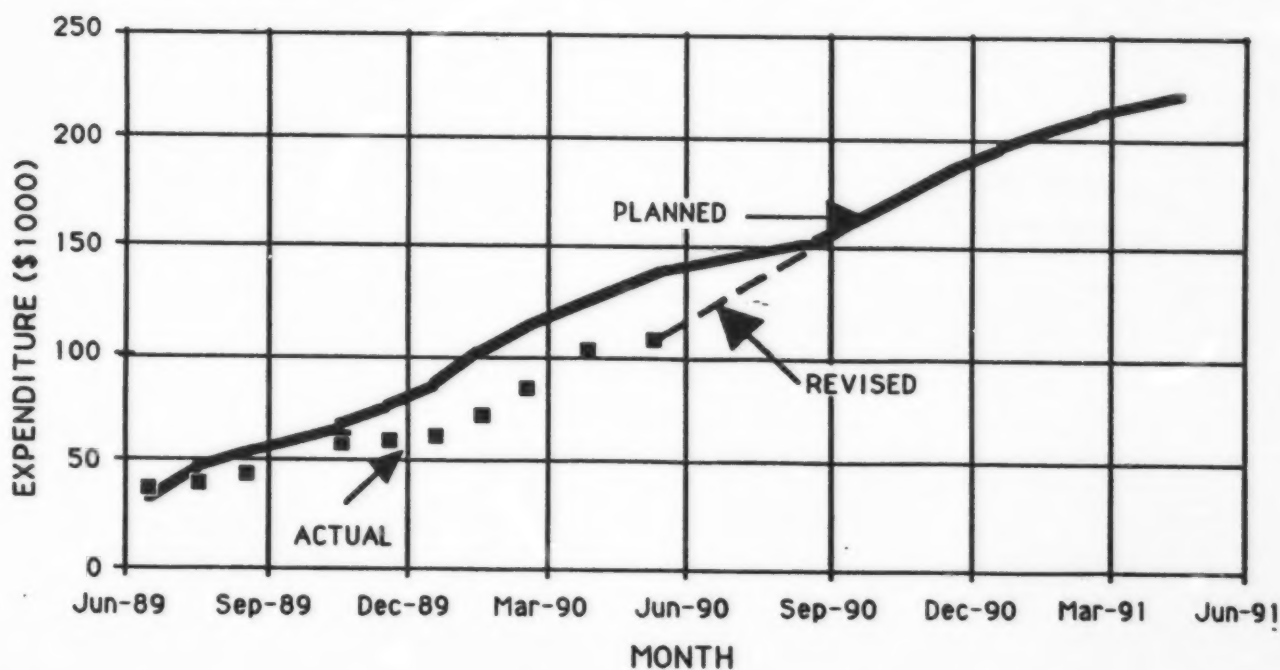
Communication is the key to the success of any management system. This is readily achieved by instituting a regular reporting schedule and making sure it is followed. The diverse locations of the participants do not present a problem if the responsibilities of the participants are clearly defined. The remarkable improvements in communications such as E-Mail, electronic networks etc. have diminished the need to have all the research team in the same location. Whereas geographic proximity assists in the exchange of information, effective communication systems with today's technology can be implemented. Networks can and do work.

Implementation of the Management System

Experience has indicated that three essential guidelines must be implemented in management of complex intersector and interdisciplinary projects. These are:

Progress and Cash Flow for the Project

Phase	% Complete		Budget		Expenditure		Remaining		Notes
	To Date	Last Report	Planned	Revised	Total	%	Total	%	
									1
									2



Notes :

- 1-
- 2-

Figure 1

1. Keep it simple and flexible: The hierarchal type of management structure or the programmed structure must be avoided at all costs. Management must be flat. There should be a Project Director who manages all the researchers and their work. Each component can have its individual leader but the leaders all report to the same Project Director who is then in the position to keep control of progress and costs. Because of the complexity within which the various participants may operate within their own organization, it is necessary that the management system be very flexible. Government participants may well have a hierarchal or pyramid-type management structure which they have to satisfy on a regular reporting basis. Industry participants may be free-floating or they may be as constrained as government. University researchers will often resist any type of management control but if they are to benefit from the research projects, they have to accept the principles of cost accounting and project scheduling normally associated with industry. They usually have teaching commitments and the ubiquitous committees of universities which must be satisfied and hence require substantial flexibility in the project execution.

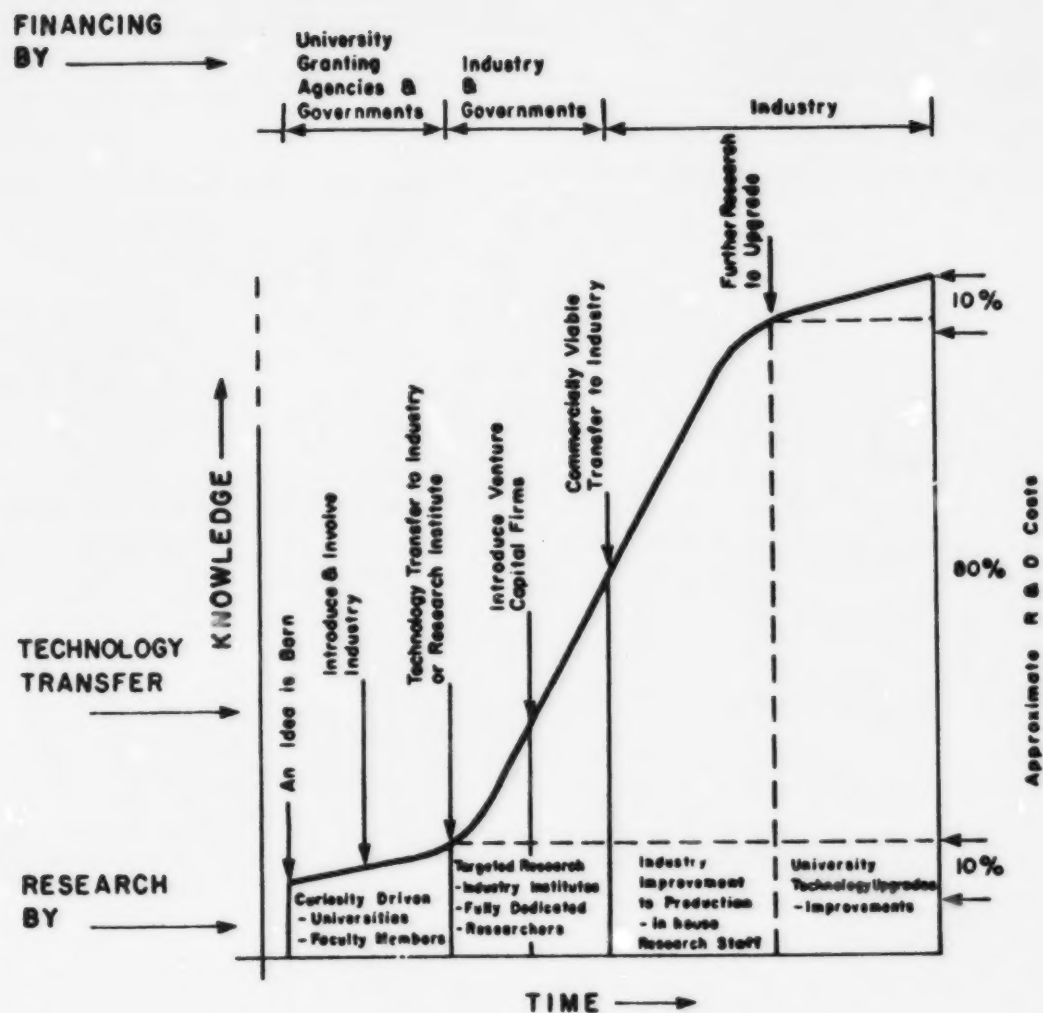
2. Know where the buck stops: All of the participants must agree that there will be one individual, usually the Project Director, responsible for maintaining the schedule and for the accounting. It is best to have a signed agreement in place accepting that condition.

3. Communicate: Communication is one of the most important issues. Each participant must be kept fully informed on progress, particularly where he or she is dealing with a component of the research that feeds into other activities.

From Idea to Commercialization

Figure 2 illustrates how we think the world should work in taking a good research idea through to commercialization. Plotted on the ordinate is a relative state of knowledge regarding the project; along the abscissa is time. The beginning of the S-Curve reflects the time required to initially develop the idea and to carry it forward in the university research environment. Progress will normally not be fast because of many other commitments which the university researcher has, and because of uncertainty in picking the right path to follow. Typically, several blind alleys will have to be entered before the research is on the right track.

At some point the research will start to move ahead and there will be an indication that this is a commercially viable concept that requires further development. At this point the work should move into a different research environment, an environment of research partnerships in which there exists a flexible but simple management system. That environment can be a research organization similar to C-CORE, an industry willing to buy into the project or a dedicated research Centre within a faculty. Let's assume that it is a research organization where the work will be carried out by full-time research assistants, under the supervision of the original conceiver of the idea. In other words, the university professor can continue his or her research in this environment, supervising an accelerated program and engage in it on a full time basis with the organization buying release time from the faculty, provided that funding has been identified.



Research - Development & Technology Transfer from an Idea to Commercialization

Ideal involvement of Industry and Venture Capital
for smooth transition.

Figure 2

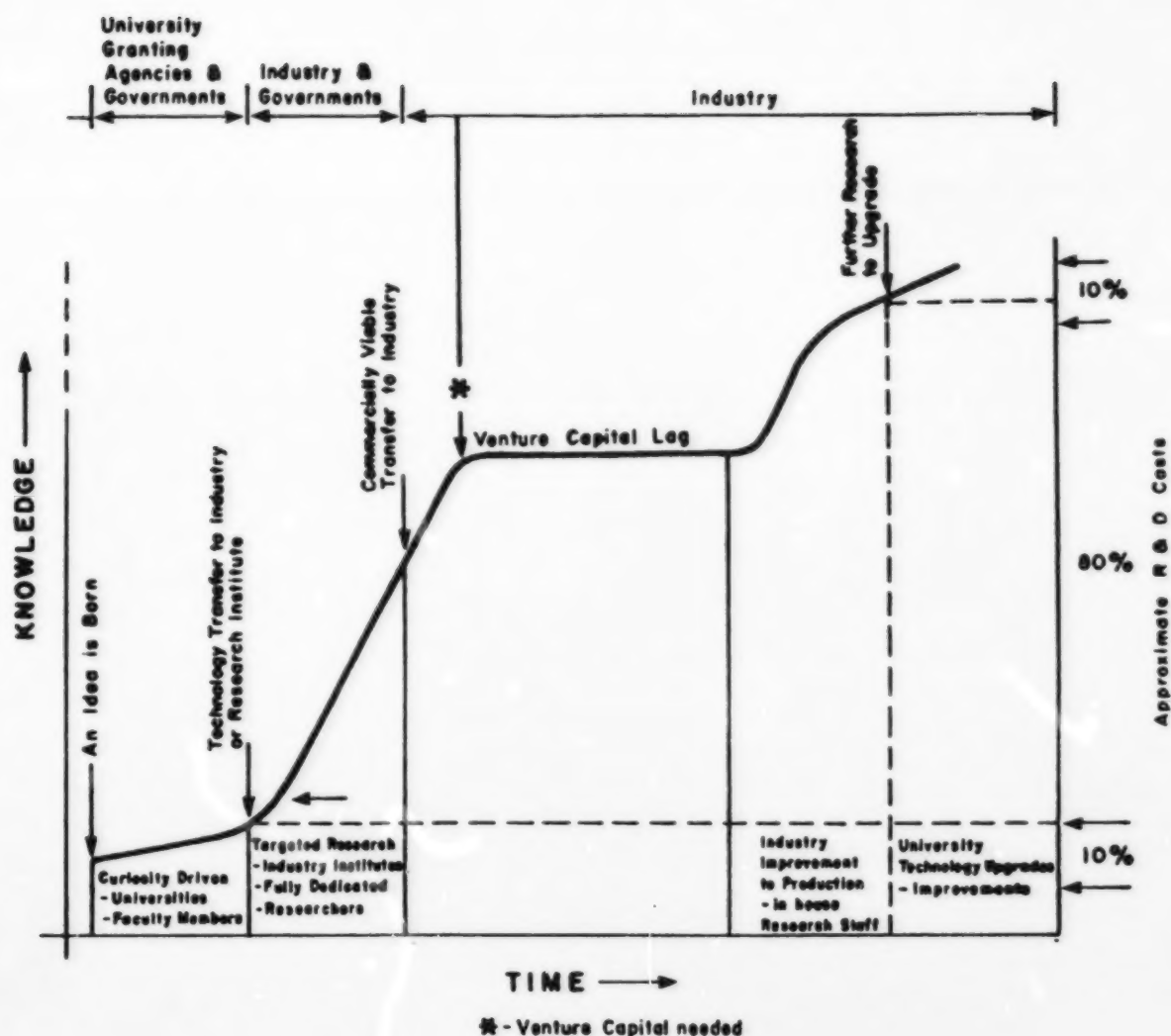
At an early stage of development, when sufficiently confident that a viable commercial entity exists, an industry partner which will take it to the marketplace should be sought and introduced to the technology. Ideally, the industry partner will play a role in the actual hands-on research so that the people involved are fully familiar with the product and how it was derived. The industry people will also provide the requirements needed to make the final product marketable. Shortly after the industry partner is introduced, it will likely be necessary to find venture capital to carry the technology to the marketplace. The venture capital people should also be introduced to the project, well ahead of the time when their money will be needed. This allows them to become comfortable with the research product and to make sure that the market potential of the technology is in keeping with their objectives. Delaying an early introduction of the technology to the venture capital investor should be avoided. When financing is available, the commercializing industry can get the product to the marketplace. From then on the research will be required primarily to upgrade the technology, and to keep the product at the leading edge. At that point it is logical that the ongoing research move back into the traditional university environment. Hence, we see an S-curve with the beginning and end of the S-shape being carried out in the university and the fast-track component being carried out in a fully-dedicated research institute or industry with a management system as described in this paper.

In C-CORE's experience, the most difficult phase is introducing the venture capital people into the partnership. This is why they should be brought to the project long before the time when their investment is needed. If this is not done, we are apt to see a situation such as illustrated by Figure 3 where we experience what we call a venture capital lag.

Conclusions

The management of multidisciplinary projects has long been a feature of industrial and military research where there was a need to harness diverse disciplinary insights to practical tasks at hand. This has been dealt with, typically, through a matrix management system, balancing manpower, time, geographical distance and leadership. However, the traditional authoritarian management systems underlying these kinds of projects are not appropriate in the 1990's, particularly in an R&D environment.

Since the early 70's corporate support for academic research has grown with a shift from passive donations and grants to a more active participation through a variety of cooperative mechanisms. Research partnerships of university, industry and government groups have grown tremendously over the last few years and will continue to grow in the future. The results of a recent survey of CEO's in the United States show that they believe that the management of research partnerships will be the challenge of the coming decade. It is in the Canadian interest that research partnerships be successful in order to maximize the research effort in a country of limited R&D resources. There is, now, a willingness seen in all of three sectors to cooperate, not just within Canada but on an international basis. It is important that those involved in research partnerships of today make them work. Key to the whole process is the implementation of a simple but flexible management system recognizing that the members of the research partnerships are professional people with a personal stake in the project to make it work.



Research - Development & Technology Transfer from an Idea to Commercialization

A Common Problem - Too late in involving Venture Capital.
- Lag in Technology Transfer -

Figure 3